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ABSTRACT

Intended to help public broadcasters make informed decisions on the use of the new technologies to enhance their services and programming, this report outlines the relative strengths and weaknesses of new applications, describes selected options that may be available to public broadcasting, and provides cost and market projections to enable broadcasters to make reasonable assessments of how the markets for new technology are developing and services that public broadcasting can provide. Capabilities of the new technologies are explained, as well as how these characteristics relate to user needs and public broadcasting's mandate. A historical perspective on the development of new communications technologies is followed by descriptions of 14 technologies that may be available to public broadcasting. These technologies are analyzed in terms of their market development and potential applications: teletext, videotext, specialized cable, interactive cable, videocassettes, teleconferencing, microcomputers, high definition television (HDTV), low-power television (LPTV), subscription television (STV), multipoint distribution services (MDS), digital audio, subsidiary communications authorization (SCA), and direct broadcast satellites (DBS). Thirty-four tables display data on market growth and a 10-item bibliography is provided. (LMM)

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TELECOMMUNICATIONS TECHNOLOGIES AND PUBLIC BROADCASTING

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CORPORATION FOR PUBLIC BROADCASTING

A REVIEW OF
TELECOMMUNICATIONS TECHNOLOGIES
AND
PUBLIC BROADCASTING

PREPARED FOR

CORPORATION FOR PUBLIC BROADCASTING

BY

JOHN CAREY AND MITCHELL MOSS

JANUARY 1984

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PREFACE

The expansion of telecommunications technology may offer public broadcasting opportunities to reach new audiences or to enhance current services. This report, and all of the research on technologies undertaken by the Corporation for Public Broadcasting, examines the use of alternative technologies to deliver public telecommunication services.

This study should help licensees and other public telecommunications entities understand the marketplace factors that will influence the general acceptance of these technologies. Marketplace considerations affect not only how soon the audiences will be prepared to use these media; they also govern the potential magnitude of the opportunities to use these media for secondary distribution of public broadcasting programming.

In deciding to use new technologies, public broadcasters must understand the competitive environment they may be entering. The Corporation's interest is to alert the enterprise to the opportunities these technologies afford them and also to provide a reasonable estimate of the technologies' potential role in the future communications environment.

This report does not urge participation in any of the technologies that show promise. Rather, it attempts to outline the relative strengths and weaknesses of new applications of technologies and describe selected options that may be available to public broadcasting. To make informed decisions on the use

of the new technologies to enhance services or programming, we must scrutinize the options from the perspective of public broadcasting policy, financial planning and community support.

This report, prepared by the Interactive Telecommunications Program at New York University, reflects the consultants' assessment of each of these technologies. The Corporation will continue to conduct a comprehensive and highly focused review of the most promising technologies in the context of their usefulness in fulfilling the public telecommunications mission.

Richard Grefe, Director
Policy Development and Planning
Corporation for Public Broadcasting
January 1984

INTRODUCTION

In seeking to understand the new telecommunications technologies and their relevance to public broadcasting, it is important to avoid a simplistic model in which certain technologies are identified as unusual market opportunities or technical advances, with an implied suggestion that public broadcasting must commit its resources to pursuing them. First, it is very difficult to predict which technologies will achieve broad acceptance by the American public and educational institutions. Second, public broadcasting functions under a different mandate than commercial organizations.

At the same time, those involved in public broadcasting need to assess how the markets for new technology are developing and what services public broadcasting can provide. By focusing on the existing literature and research findings about new telecommunication technologies, this review provides a basis for reasoned and reasonable assessments. Many of these estimates of growth for new technologies are more conservative than those of the trade press and some well-known market analysts. Clearly, there is room for alternative projections. But this methodology is both reasonable and sound. The results make a strong case for conservative positioning in relation to the new technologies. In any event, the methods are described in order that the reader may take the figures presented and consider them in the context of an alternative methodology.

In addition, new technologies are scrutinized from the perspective of public broadcasting's mandate. Here too, it will become apparent that the assessment of how advanced telecommunications technologies can serve the cultural, educational, and information needs of citizens is cautious. It is not our intent to discourage involvement by public broadcasting in the development of new services. Rather, our purpose is to apply a rigorous analysis in order that the strongest ideas might emerge.

There are four components to this report. Chapter 1 explains what the new telecommunications technologies can do and how these characteristics relate to user needs and public broadcasting's mandate. Chapter 2 provides a historical perspective on the development of communications technologies. Chapters 3 through 8 analyze specific new technologies in terms of their market development and potential applications. Chapter 9 presents conclusions along with selected options for public broadcasting.

1. CLASSIFYING THE NEW TECHNOLOGIES

Engineering developments rather than user needs have been the impetus behind much recent analysis of new telecommunications technologies. From a service perspective, this is putting the cart before the horse. The mere development of videodiscs or microcomputers should not cause a service provider to stop and adopt the latest piece of equipment. The value of new technologies comes from the manner in which they serve the needs and fulfill the desires of users.

One way to help put the new technologies into their proper perspective is to describe them in different contexts: provision of services, general media characteristics, public broadcasting mandate issues and audience economic characteristics. By using these categories, it is easier to understand what the new technologies can and cannot do.

This report considers fourteen technologies:

- Teletext
- Videotext
- Specialized cable
- Interactive cable
- Videocassettes
- Teleconferencing
- Microcomputers
- High definition television (HDTV)
- Low-power television (LPTV)
- Subscription television (STV)
- Multipoint distribution services (MDS)
- Digital audio
- Subsidiary communications authorization (SCA)
- Direct broadcast satellites (DBS)

To begin, it is reasonable to outline some general media characteristics that affect how audiences make use of services (Table 1).

Table 1. Characteristics of the New Technologies

Characteristic	Description	Technology
One-way	User can receive only; flow is source to user only	Teletext, LPTV, STV, MDS, DBS, pay cable, SCA, some specialized cable channels
Interactive	User can both send and receive; flow is source to user and user to source	Interactive cable, videotext, videodisc, teleconferencing, some specialized cable, microcomputers
Stand alone	User controls product in home or business	Digital audio, audio cassettes, videodiscs, videocassettes, microcomputers
Transmitted	User receives product from a source outside his home or business	SCA, DBS, LPTV, teletext, cable TV, HDTV, STV, MDS, conventional broadcast
User supported	User pays to receive the product	Pay cable, teleconferencing, videotext, videocassettes, videodisc, microcomputer software, STV, MDS, digital audio, DBS, some SCA and LPTV
Sponsor supported	A company, government agency or foundation pays for the product and means of delivery	Teletext, conventional broadcast, some SCA and LPTV

Continued on next page

Table 1--continued

Characteristic	Description	Technology
User transparent	User can understand and begin to use technology without special training	Videocassettes, videodiscs, cable, HDTV, LPTV, STV, MDS, digital audio, DBS, SCA, conventional broadcast
Requires user training	User must learn new skills to employ technology	Teletext, videotext, interactive cable, teleconferencing, microcomputers
On demand	User receives information he chooses; user controls the timeframe	Teletext, videotext, some applications of interactive and pay cable, videocassettes, videodiscs, teleconferencing, digital audio, microcomputers
Scheduled	User can receive information only at prearranged times, not under his control	Conventional broadcast, most cable TV, HDTV, LPTV, STV, MDS, DBS, SCA, teleconferencing

A second grid in this taxonomy relates to services. Broadly, services may be grouped under five categories: information, education, entertainment, messaging and communication, and transactions. These in turn are composed of many subgroupings. Table 2 outlines the subgroupings, along with the likely audiences for the services.

Focusing specifically upon public broadcasting, it is important to relate new technologies, services and programming to the mandate and policies that underlie public broadcasting activities. Some of the more relevant policy issues can be formulated as additional elements in the taxonomy (Table 3).

Table 2. Services and Audiences for the New Technologies

Category	Services	Consumer Audiences/Users	Institutional Audiences/Users
Information	Teletext and videotext (weather, business information, news, consumer information), specialized cable and SCA information programs	Upper income families, farmers, professional workers, handicapped citizens, cable subscribers, microcomputer users	Microcomputer and database access by institutions, schools and businesses
Education	Microcomputers (CAI), interactive cable, videocassettes, videodiscs, teleconferencing	Continuing education, high school and college students, microcomputer users	Colleges, high schools, employee training, hospitals, armed services, trade unions
Messaging and Communication	Electronic mail, word processing, teleconferencing	Microcomputer users and hobbyists, U.S. mail replacement	Intracompany communications, U.S. mail replacement, electronic business meetings
Entertainment	Pay cable, specialized cable, DBS, MDS, STV, microcomputer games, videocassettes, videodiscs, digital audio, HDTV, videogames	Home consumers with discretionary income, microcomputer users and hobbyists	Video games in arcades, colleges, cable services in offices
Transactions	Smart cards, home banking, videotext, interactive cable, on-line shopping, electronic airline reservations	Busy urban families, isolated rural families, microcomputer users and hobbyists	Banks, direct marketing groups, catalog merchants, on-line ordering and stock control

Table 3. Public Broadcasting's Mandate and the New Technologies

Policy Issue	Technology
Diversity of program and information sources	Low-budget production technology in conjunction with the existing satellite distribution system and new local-loop distribution vehicles (e.g., dual trunk cable) can be used to foster diversity of program sources. Personal computers can be used to create a greater number of information sources for teletext and videotext services.
Help those who need information services: the blind, the deaf and those with special health problems	SCA, teletext, low-power television and nonbroadcast information services such as videodisc, microcomputers and videotext can help meet these needs.
Convenience and choice: the ability of viewers and listeners to watch or hear what they want, when they want	Cable, SCA, audio/videocassettes and videodiscs can provide a means of secondary distribution that will give viewers and listeners more options on choice of programming and time of viewing/listening.
More audience involvement	Interactive programming technologies such as two-way cable can permit more audience participation. Nonbroadcast technology such as audio/videocassettes can be used in a group setting to replay and discuss programming.
Mass audience vs. select audiences	Interactive programming technologies, nonbroadcast technology, and local dissemination of programs through cable, low-power television and microwave systems enhance the potential of select audience programs.
Innovation	Generally the new technologies provide means for public broadcasting to innovate new services. Indeed public broadcasting has been a major innovator in teletext, videodisc and satellite transmission. One current need is to use innovative techniques to create low budget programming for the new services.

It is important to ask: Who can afford these new services? The complete "electronic home" of the 1980s with a personal computer, videocassette player, videotext subscription and selective additional services will require a capital outlay of approximately $6,000 as well as monthly payments of approximately $250.

For the purposes of this exercise, Table 4 describes five categories of users (based on income available to spend on media) and the technologies they can probably afford.

Table 4. Media Budgets for New Technologies

Budget	Available Services
Low-income household: 24 percent of U.S. households have a yearly income under $12,500. A typical low-income household has a TV, radio and telephone but has no disposable income for new technologies	Conventional broadcasting and low-power television
Middle-income household: 52 percent of U.S. households have a yearly income between $12,500 and $35,000. A typical middle-income household can spend $2,500 over a five-year period for equipment and $25 to $50 per month for rental fees, software, etc.	Teletext, videocassette player, low-power TV, audiocassettes, specialized pay/interactive cable, videogames and a low-end personal computer
Upper-income household: 24 percent of U.S. households have a yearly income over $35,000. A typical upper-income household can spend $3,000 to $5,000 over a five-year period for equipment and $75 to $100 per month for rental fees, software, etc.	Teletext, videotext, low-power television, videocassettes, videodiscs, DBS, digital audio, audiocassettes, specialized pay/interactive cable and a high-end personal computer

Continued on next page

Table 4--continued

Budget	Available Services
Secondary school with an annual budget of $25,000 for new telecommunications services.	Teletext, videotext, videodiscs, videocassettes, interactive cable, SCA, microcomputers, computer message system, audioconferencing, low-power TV, digital audio, audiocassettes
Large corporation prepared to spend $1 million per year for new telecommunications services in support of employee training and intracorporate communication.	Teletext, videotext, videodiscs, videocassettes, interactive cable, SCA, microcomputers, MDS, DBS, audio/videoconferencing, electronic mail, specialized in-house cable, computer conferencing, local loop technology, satellite data transmission, on-line database services

It is difficult to integrate Tables 1 through 4 within a simple conceptual framework. But one can arbitrarily group new services under three broad headings. These headings overlap, with some services in more than one group.

1. Limited Audience Services: Secondary Distribution

Specialized cable channels, MDS, LPTV, videodiscs, videocassettes and SCA all provide a means to reach select, limited audiences. They provide secondary distribution channels, as opposed to the primary channels (existing public broadcasting television and radio stations). A few general issues may be identified in relation to secondary distribution.

- There is no one ideal means of secondary distribution for all areas of the country. Choice must be based on availability (e.g., a city may not have a cable

system). Choice should also be based on the suitability of a distribution channel for the policy objectives of public broadcasting.

- Secondary distribution channels can be a problem if public broadcasting sees itself as providing all programs for all people. To the degree that select audience programming is encouraged, the secondary distribution channels can provide an efficient way to reach many of those audiences.

- It should not be assumed that a primary distribution channel such as an existing over-the-air public television or public radio station will coordinate its selection of programs with the secondary distribution channels. They might compete as well as coordinate. Some form of local public entity may be needed to coordinate the various distribution channels.

- On a regional and national level, coordination probably will be needed to help regional networks (for example, when stations in the Southwest want to share programming); special interest networks (for example, stations in the large cities); and ad hoc networks (for example, stations who want to get together on a one-time basis because of a special problem). Some of the existing regional and special interest networks, such as the Southern Educational Communication Association, may be valuable resources for coordination expertise.

2. Telecommunications Services

A range of new technologies other than broadcast television and radio can provide new information, entertainment and educational services. The first broad question is whether public broadcasting entities should become involved in providing telecommunications services. If the answer is yes then additional questions must be answered:

- What criteria should be applied in determining the type of telecommunications services to be provided by public broadcasting? Who will pay for these services and how?

- Should public broadcasting consider a series of joint ventures with private industry groups to provide telecommunications services?
- How will services provided by public broadcasting compete with or complement services provided by the private sector?
- Are there telecommunications services that the marketplace will not provide but that should be considered by public broadcasting?

3. Interactive Programming

Interactive programming, as in two-way cable, represents a commitment to involve the community in programming and to bring together people who are separated physically. In addition, interactive programming can focus upon the needs of specialized groups and allow them to communicate directly with the station and with the broader community.

Interactive programs require more organizational work than most one-way programs. A station's role would change from service provider (the predominant role now) to facilitator working with community groups.

Some of the critical issues in deciding to develop interactive programming are--

- Does the existing or proposed cable system have interactive capability? If so, are there costs for linking various sites within the community with the local public television station to provide two-way programming?
- What kinds of programs are suitable to interactive formats? What organizations or groups would participate in interactive programming?
- What types of financial and management structures should be used to organize and conduct interactive programming?

- How can interactive programming reinforce the role of public broadcasting within the local community?

- What are the demographic characteristics of those who subscribe to cable and can participate in interactive programming? Can the intended audience for the programs actually receive them?

2. TECHNOLOGY DEVELOPMENT

In order to assess the development of new technologies, it is useful to establish a baseline against which to measure growth. For this analysis a baseline has been constructed with three components: historical development and growth of established media such as newspapers, radio and television; development of more recently introduced media such as pay television, videocassette recorders and videotext; and current expenditures on media.

Many of the commonplace assumptions about the growth of new communication technologies are based on radio and television, which grew very rapidly once they were made available to the public. Most communication technologies that are part of our everyday lives, however, required years to achieve mass penetration. Some of the media that have achieved mass penetration of U.S. households are examined in Table 5. It is evident that most media required several decades to reach a 50 percent penetration level.

Table 5. Market Penetrations of Established Media

Media	Years to Reach 50% U.S. Household Penetration
Newspapers	100+
Telephone	70
Phonograph	55
Radio	10
Black & White TV	10

Sources: DeFleur 1970; Electronic Data Book 1983; Sterling and Haight 1978.

Although we accept the telephone as a basic component of U.S. households, it was primarily a business tool during its first 50 years of growth. It was not until after World War II that most households leased a telephone. Similarly, the newspaper, available since before the American Revolution, was a medium for businesses and a small group of professionals until the end of the 19th century. At that time, favorable postal rates for newspapers, increased literacy and advances in printing technology helped the newspaper reach half of all U.S. households.

Table 6 shows the growth of recent technologies with at least five years exposure on the market. Note that in Table 6 and throughout this report, the base is all U.S. households, not households with television. If one were to use households with television as a base, the percentages would be slightly higher.

Table 6. Market Penetrations of Recent Technologies

Service	Years Available To Consumers	Percent Penetration U.S. Households Fall 1983*
Cable TV	32	34
Pay TV (all forms)	11	22
Video Games	8	14
VCR	8	8
Personal Computers	7	7

Sources: Business Week; Electronic Industries Association; The New York Times.

* The base is 85 million U.S. households.

It is noteworthy that cable television required 30 years to enter one-quarter of American households, while videocassette recorders in eight years have entered over eight percent of households. Both of these technolcgies are regarded as highly successful, yet their growth patterns are quite different from those of radio and television.

Another useful way to slice the same historical pie is to examine rates of growth during the first five years and then the first ten years of availability. By plotting the development of communication technologies from this perspective, it becomes clear that very few telecommunications services experience more than a 100 percent growth rate during each year of the first ten years of availability.

Table 7. Growth Rates for New Technologies

Service	Average Growth Rate Per Year During First Five Years	Average Growth Rate Per Year During First Ten Years
Telephone	80%	50%
Black & White TV	320	190
Color TV	133	88
Radio	157	77
Cable TV	90	51
Pay TV	182	135
VCR (Business & Home)	85	60
Average With TV	134	93
Average Without TV	111	77

Sources: Electronic Industries Association; R.W. Hough & Associates.

Table 7 suggests a useful baseline against which to compare the growth of new telecommunications technologies: the mean rate of growth for existing communications services during their introduction to the marketplace. If one includes black and white television in this group, the average rate of growth for a telecommunications technology during its first five years is 134 percent. Without television, the average rate of growth has been 111 percent. In applying this mean, one must also consider first-year sales, which will vary considerably. This sales figure in turn affects the rate of growth during subsequent years.

Alternatively, one may examine a new technology with three or four years in the marketplace and compare it to an older technology that had a similar growth rate in its first three or four years. The growth rate for the older technology over the next several years then provides a reasonable basis for estimating the growth of the new technology. Positive or negative market elements associated with the new technology may provide a basis for altering the forecast up or down.

Curiously, this research provides very few examples of technologies that had a slow growth for the first five years followed by a large growth rate in years five through ten. Yet, such a growth curve is commonly suggested by those who are marketing new technologies that have a poor early sales record.

Decline of Previously Successful Technologies

In establishing a baseline for growth of technologies, it is important to review communications technologies that have declined and the reasons for this decline. The principles and lessons that emerge from such a review can be applied to an assessment of technologies about to enter the marketplace.

- CB Radio. Citizen band (CB) radio sales and licenses reached a peak in 1976 and have declined sharply in the past seven years. It appears that CB radio had a steady population of approximately 200,000 users in the early 1970s when it became a fad. Usage then grew very rapidly but declined at a nearly equal rate after 1976. The population of users may now be leveling off to approximately one million individuals. This figure is five times the 1970 base, but only one-tenth of the peak of approximately 10 million users.

  Thus CB radio may represent a small and relatively stable service that became a fad, grew rapidly, and ultimately settled back to a larger population of users than existed before the fad cycle began. Clearly it would have been a mistake to assume in 1976 that CB would continue to grow at a very rapid rate and eventually enter most American homes.

- Records. After World War II, the record industry grew at a moderate but steady rate. It experienced a changeover from 78s to 45s and 33 LPs during the 1950s. Since then, however, the total number of records manufactured has leveled off, and the number of new titles released has declined. The record industry has been affected by growth in the use of cassette tapes; increased competition from nonmusic products for entertainment dollars; and the absence of technological developments that might generate renewed interest in recordings (quadraphonic sound failed in the marketplace).

  In 1983, the record industry began to show signs of renewed strength. Curiously, the attractiveness of a potential competitor, music videos on cable, led to a short-term benefit for the record industry by encouraging the purchase of recordings of artists who appeared on music videos. In addition, the introduction of digital audio brought public attention

to the record industry. It remains unclear, however, whether the record industry is beginning a new cycle of growth or deviating momentarily from a long-term pattern of decline.

- Instant Cameras. Since their introduction to consumers in the 1950s, instant cameras (Polaroid and later Kodak) grew steadily until 1978, when the market peaked at 13.8 million units sold. Since then sales have declined 10 to 15 percent per year. It appears that instant cameras have been affected by other popular consumer electronic products such as video games, as well as a general decline in "car vacations" when cameras are used heavily.

  The instant camera has prospered for too long to be described as a fad. It may represent a technology, like the 78 record, that runs its course in the marketplace and is eventually replaced. Alternatively, it may settle back to a reduced level of usage and remain there for the foreseeable future. It is difficult, however, to construct a scenario of continued and rapid growth for instant cameras.

The telegraph represents another technology that ran a long course of development, decline and displacement by another medium -- the telephone. In addition, there are strong signs that 8mm and Super 8mm movie cameras are being replaced as a home movie medium by half-inch videocassette and home video cameras.

In general, it appears that technologies decline because they represent a fad, encounter superior competition from new technologies, or lose appeal in a marketplace of abundant choice. In the latter case, people displace money from technology X for technology Y that provides a new service, rather than a competing one.

Outright Failures

Among a long list of outright failures, two examples illustrate some important principles that commonly underlie failures in new telecommunications technologies.

- Quadraphonic Sound. Four-channel sound, for the consumer market, did not represent an advance in technology. Rather, it represented an application of existing industrial technology (multitrack recording and playback) with a genuine industrial benefit (control of editing) into a home market where no benefit could be demonstrated. In addition, very little software was developed for the new system, thus further reducing its appeal to consumers.

- Picturephone. The market history of the picturephone is well known. It provided a superficial benefit (a low resolution image of a person at the other end of a phone conversation) that consumers did not want, and it never solved the network problem (a person with a picturephone requires a network of other people with picturephones). But one of the general lessons associated with the picturephone story masks a more fundamental principle: The picturephone is often cited as an example of a technology that proved successful in market testing, only to fail in the marketplace. This is not the case. There was abundant evidence in the market testing of the picturephone that it would fail. AT&T ignored this evidence because it had already invested many millions of dollars in the product and had attracted enormous public attention. Some of the technologies in the 1980s appear to be in the same position of attracting enormous attention from the trade press while evidence from market trials is decidedly negative.

Comebacks and Cyclical Technologies

Another class of technologies, including 3-D movies and video teleconferencing, have experienced periodic introduction, decline and reintroduction into the marketplace. Typically, these technologies experience a limited success but do not

take hold of a market or grow. After a period of hibernation, some business analysts suggest that the market has become "ready" for the technology and it is reintroduced. In the cases of both the 3-D movies of the 1950s and video teleconferencing of the late 1960s and early 1970s, high costs and technical problems or limitations appear to have weakened their chances in the marketplace. But some also argue that the services they offered represented technology push rather than user demand. Recent and renewed interest in 3-D movies and video teleconferencing, along with some resolution of economic and technical problems associated with their use, may provide a basis for better understanding of cyclical technologies.

Consumer Expenditures

In establishing a baseline of consumer expenditures on communication technologies, it is useful to present figures on household incomes (Table 8) and penetration of new technologies under analysis in this report (Table 9).

Table 8. U.S. Household Income, 1981

Annual Household Income	Percent of U.S. Households
Under $10,000	23%
$10,000 - $20,000	25
$20,000 - $40,000	35
$40,000 - $80,000	16
Over $80,000	1

Source: The New York Times, February 2, 1982.

Table 9. U.S. Household Penetration of New Technologies, 1983

Service	Percent Penetration Fall 1983
Basic Cable TV	34.2%
Pay Cable	20.4
STV	1.0
MDS	0.6
VCR	8.2
Video Games	14.0
Videodisc	0.7
Personal Computers	6.6
Videotext	0.1

Sources: Federal Communications Commission; Paul Kagan Associates; Broadcasting Magazine; CableVision; The New York Times.

In addition, it may be noted that approximately 98 percent of U.S. households have one or more televisions (over 75 percent have two or more); 98.5 percent have one or more radios; and 77 percent subscribe to or regularly purchase a newspaper. Table 10 presents consumer expenditures on selected video products in 1981 (television sets are excluded from the table).

Table 10. Household Expenditures on New Video Products, 1981

Product/Service	Total Expenditure (in millions)	Percent of Total
Basic Cable	$1,910	36.2%
Pay Cable	863	16.4
VCR	1,280	24.4
Personal Computer	305	5.8
Video Game Units	554	10.5
STV	179	3.4
MDS	116	2.2
Videodisc Player	56	1.1
Total	$5,268	100.0

Sources: Federal Communications Commission; CableVision; Television Factbook; The New York Times.

The baseline we have constructed suggests that most of the new technologies that ultimately succeed will grow at a moderate pace-- just over 100 percent annually in the first five years, and 77 percent annually averaged over the first ten years. In addition, many new products are likely to fail. They will not provide a perceived benefit or will fall to the competition from many other electronic products, each of which vies for limited consumer dollars.

3. SPECIALIZED CABLE SERVICES

Specialized cable services have attracted enormous attention from both the public and private sectors. This is understandable in light of the growth in cable penetration (more than 34 percent of U.S. households providing gross revenues of approximately $2 billion for basic cable services). The early strength of pay cable services is even more noteworthy: a growth rate of 182 percent in its first five years; more than 20 percent penetration of U.S. households eleven years after its introduction; 60 percent penetration of homes that subscribe to basic cable; and gross revenues just under $1 billion for pay channels during 1982.

Our assessment of market penetration for cable suggests continued strong growth through 1990 (Table 11).

Table 11. Projected Growth for Basic and Pay Cable Through 1990

(Households in millions)

	Fall 1983		1985		1990	
	House-Holds*	Percent of Total	House-Holds*	Percent of Total	House-Holds*	Percent of Total
Basic Cable	29.1	34.2%	35.1	39.4%	47.6	48.6%
Pay Cable	17.3	20.4	23.4	26.3	35.5	36.2

Sources: CableVision; U.S. Department of Commerce.
Projections: Carey and Moss

* The base for households is 1983, 85 million; 1985, 89 million; 1990, 98 million.

Currently, basic cable subscriptions average $8 to $10 per month. The mean charge for a pay service is $9 to $10. The average home subscribing to cable pays approximately $18 to $20 a month for cable. Our analysis suggests that while basic cable service and pay services will grow, and households will pay more for cable, a realistic projection of per household expenditures on cable is approximately $30 to $35 per month by 1990, not the $40 to $50 per month some analysts have suggested. Nonetheless, $30 to $35 per month would represent very large revenues for cable operators and service providers (approximately $15 billion per year gross revenue by 1990).

With such large potential revenues available to broadcasters, newspapers and publishers, there has been tremendous momentum toward developing specialized cable services. Table 12 provides a simple breakdown of specialized cable channels in terms of content area or target audience. Since 1976, when three specialized cable channels were available, the offerings have burgeoned to over 70 specialized channels in 1984. But fewer than 10 percent of these specialized channels showed a profit in 1983, and several have failed entirely.

Table 12. Specialized Cable Channels, 1984

Content/Target Audience	Channels	Percent of Total
Sports	10	13%
Movies	9	12
Audio Services	9	12
Public Affairs/News	7	9
Religion	7	9
General Entertainment	6	8
Music Video	6	8
Ethnic/Foreign Language	5	7
Text Service	5	7
Children	2	3
Arts	2	3
Education	2	3
Games	2	3
Shopping	1	1
Health	1	1
Women	1	1
Business	1	1
Total*	76	101%

Source: Carey and Moss

* The percentage total is 101 due to rounding.

Many organizations are actively planning new specialized cable services. A number of problems and barriers, however, accompany entry into specialized cable services.

The first is system capacity. In 1983, approximately 40 percent of U.S. cable system had a capacity of 12 channels or fewer. By 1985, fewer than half will have a capacity of 30 channels or more. The recent construction of several very large systems in Dallas, Cincinnati and Pittsburgh has created a sense of unlimited capacity. A reasonable estimate is that by 1990 approximately 20 percent of cable homes will be wired for 100 or more channels. As a consequence, approximately 80 to 100 specialized cable services in the mid-1980s will be competing heavily for limited channels.

In addition, current experience with multiple-tier pay services suggests that of the 60 to 70 percent of new subscribers who opt for pay services, most limit their choices to one or two pay channels (average 1.8). There has been resistance to the purchase of more than two pay services and, based on existing consumer habits, fewer than one-third of new cable subscribers can be expected to purchase three or more pay channels on a continuing basis.

These figures are sobering for public broadcasting if one reviews further the choices of pay subscribers. Overwhelmingly, the choice of homes that subscribe to one pay service is a movie channel. Of homes subscribing to two pay channels, the overwhelming choices are two movie channels, with a small percentage choosing one movie and one sports

channel. Thus a public broadcaster and all other nonmovie, nonsports service providers will be competing for 20 to 30 percent of cable homes that might subscribe to one of their services--if the system operator carries the channel.

By the mid-to-late 1980s, many specialized cable services will probably have failed, and the apparent rush to enter cable will have subsided. At that time, a pay channel for arts programming may encounter a more benign market. Also, the number of large capacity cable systems will have grown significantly by the second half of the decade.

Leasing

Channel leasing, an option available to many service providers in the past, has become problematic. In a cable leasing arrangement, the service provider pays a fixed fee or fee per subscriber to the cable operator for control of a channel over the period of the contract. A commercial service provider may then sell advertising space or, under some arrangements, offer the service with a direct subscription charge to viewers.

Opportunities for leasing have been drastically reduced during the past five years for a number of reasons.[1] First, most cable system franchises do not require the cable operator to offer channel space on a leasing basis. Given a legal

1. See Kathleen Criner and Raymond Gallagher, "Current Activities in Channel Leasing and Other Local Service Ventures," (Washington, D.C.: American Newspaper Publishers Association, 1982).

environment in which the cable operator holds all the cards, most operators have adopted policies that avoid any long-term contracts, emphasize joint ventures with those who seek to offer a service, and are flexible in assigning channel space. Cable operators realize that far more services will be available to them through 1986 than they can accommodate.

Therefore, leasing does not appear to be a viable option for public broadcasting (under most circumstances), unless a legislative remedy is forthcoming.

Interactive Cable

Interactive cable television has received a great deal of attention, in large part as a result of promotional activities by Warner Amex for its QUBE system in Columbus, Ohio. A majority of the large cable systems to be built in the 1980s also will have some interactive capability--a feature that multiple system operators advertise with fanfare. But the opportunities for national, interactive cable programming (as opposed to text-based services described later in this report) do not appear strong in the period 1984-85 primarily because of the small number of cable homes with interactive capacity.[2] The growth rate for such capacity will be moderate

2. Many cable operators claim to have interactive services when in fact they do not have an interactive cable system, that is, a cable operator who uses telephone call-in programs can claim to have interactive services. In this report, interactive capacity is defined as the ability of a cable subscriber to communicate in some form to the cable headend through the cable.

throughout the 1980s (see Table 13).

Table 13. Projected Growth in Number of Homes with Two-Way Cable, 1983-90

Year	Two-Way Cable Homes	Percent of All Cable Homes
1983 (fall)	300 Thousand	1.0%
1985	2.6 Million	7.6
1990	9.6 Million	21.4

Source: Interactive Telecommunications Program

In addition, many of the new interactive systems are designed primarily for interactive text services: videotext, home shopping and home banking. They have limited program potential. It may be noted however that San Diego, St. Paul, Dallas and Pittsburgh, among other cities, will have a very large interactive capacity in the mid-1980s. In these areas, interactive programming opportunities may exist for local public broadcast stations. Interactive cable also has been demonstrated as a useful tool in telecourses, where students can answer multiple choice questions, review materials at their own pace and compare their answers or opinions with those of other students.[3]

3. Public broadcasting stations KUON and KPBS have developed interactive courses for cable. See Kathleen Goodfriend, et al., Final Report of the KPBS Interactive Videotex Project, (San Diego: KPBS, San Diego State University, 1982). Also, The Annenberg/CPB Project has funded the development of interactive telecourse materials by a consortium of stations that includes KPBS, KUON, WGBH and WHA. See John Carey, Electronic Text And Higher Education, (San Diego: The Electronic Text Consortium, 1983).

Specialized Local Cable Programming

Opportunities for specialized local cable programming vary greatly from market to market. While the leasing of a channel is not a viable option in most areas, many local public broadcasters can negotiate for channel time as part of a joint venture with the local cable operator or under the terms of the franchise agreement between the cable operator and a local government agency to provide education programming.

By providing specialized programming, the local public broadcaster could reach some minority and special interest audiences not currently served by over-the-air programming. Many of the underserved audiences, however, do not subscribe to cable. It may be argued, therefore, that specialized local cable programming could strain limited financial resources while reaching cable subscribers who comprise a much smaller percentage of the local audience than those receiving over-the-air programming. The strongest case can be made for offering telecourses with tuition payments by the participants in the cable-delivered course.

Modest opportunities for revenue may exist in some areas through providing service to a local cable operator and others who wish to create programming for cable. These services would include renting facilities for production and creating programs under contract to the cable operator, local colleges and local businesses. In addition, the public broadcast station may act as a programming resource for new cable systems under contract to municipalities who must provide community services.

At the moment, cable companies who are active in bidding for franchises, as well as those who have recently been awarded franchises, have been making extraordinary promises concerning local community services. It appears that many of these companies have not analyzed how programming will be created or where it will come from. As municipalities eventually demand fulfillment of these contracts, the local public broadcaster may become an obvious resource for the cable operator.

4. ELECTRONIC TEXT SERVICES

Electronic text services may be delivered via telephone wire (videotext), broadcast television (teletext) and cable (cabletext). For purposes of analysis, each of these services may be characterized in terms of four significant elements: size of service, degree of interactivity, opportunities for cost recovery, and types of service that can be provided by the carrier (Table 14).

Table 14. General Characteristics of Electronic Text Services

Name	Cost Recovery	Size of Service	Interactivity	Service Provided
Teletext	Advertising	Approx. 100 pages per channel	One-way	Information
Videotext	Advertising and/or user subscription	Unlimited	Two-way	Information, banking, shopping, messaging
Cabletext	Advertising and/or user subscription	100 pages VBI; 4000 pages for full channel	One-way or two-way	Information, banking, shopping, messaging

Videotext

Videotext appears to be the most robust of the electronic text services, with the greatest number of options for service providers and users. For this reason, it attracted far more attention than cabletext or teletext in the period from 1975 through 1981. Some early results from videotext trials and services have been mixed, however. The data suggest that videotext is generally expensive for operators and consumers alike. While many users like videotext, they are not willing to pay very much in order to receive it.

Even when videotext was provided free, usage declined as the novelty wore off. Both the U.S. government's Green Thumb project for farmers and the AT&T/Knight-Ridder trial for consumers in Florida illustrated the phenomenon. In Great Britain, where British Telecom invested more than $200 million in the Prestel videotext service, consumer usage has been disappointing. Fewer than 4,000 consumers subscribe to Prestel. Business usage has been moderate with a few applications such as information for travel agents achieving heavy usage. It is reported, however, that fewer than 10 percent of the 140 information providers for Prestel are earning a profit. In addition, there have been several tests initiated by the British Council for Educational Technology (CET) to learn whether Prestel can provide a useful tool for educators. The reactions by students and teachers have been generally positive, but there has also been much concern about the high costs associated with

Prestel. The growth of Prestel is outlined in Table 15.

Table 15. Growth of Prestel Videotext Service, 1979-83

Subscribers	1979	1980	1981	1982	Fall 1983
Business	1,400	7,000	11,400	17,200	28,500
Consumer	400	1,000	1,600	2,800	3,500
Total	1,800	8,000	13,000	20,000	32,000

Source: British Telecom, Mills & Allen

There are three major U.S. videotext services: Dow Jones, Source Telecomputing (a subsidiary of Reader's Digest), and CompuServe (a subsidiary of H&R Block). These serve business groups primarily as well as some home subscribers. Their growth is outlined in Table 16. In addition, AT&T and Knight-Ridder began a trial service in November 1983, aimed at consumers and businesses in southern Florida.

Table 16. Growth of U.S. Videotext Services, 1979-83

Service	1979	1980	1981	1982	Fall 1983
Dow Jones	6,000	13,500	29,000	54,000	85,000
Source	3,000	7,000	13,500	26,000	40,000
CompuServe	1,000	4,000	18,000	35,000	65,000
Totals*	10,000	24,500	60,500	115,000	190,000

Source: Interactive Telecommunications Program

* Approximately 20 to 25 percent of these subscribers are estimated to be consumer households.

While the growth rate among consumer (home) subscribers has been moderate, the base from which growth is measured falls in a low range. Applying historical technology growth estimates to this base, one could tabulate a projection of growth for the remainder of the decade at 65 to 70 percent annually over the first ten years. This would yield an estimated penetration of two percent of U.S. households in 1990. This estimate of penetration in the consumer market for videotext information services is considerably below many predictions in the trade press. The data we have analyzed, however, provide few reasons for a more optimistic scenario for services in which information is the principal commodity. Perhaps for this reason, alternative configurations of videotext are beginning to emerge. Both existing videotext services such as Source Telecomputing and trial services such as the one provided in the recently completed CBS videotext trial in Ridgewood, New Jersey, have been placing greater emphasis on transactional videotext services. These include electronic mail, home banking and home shopping. It is not yet clear how the public will respond to these alternative configurations of videotext.

Teletext

Teletext has found strong market acceptance in Great Britain. Beginning with a test service in 1976, teletext is now received in six percent of British households (Table 17).

Table 17. British Teletext Market Growth, 1976-83

Year	Decoders in Consumer Homes* (units)
1976	3,000
1977	6,000
1978	13,000
1979	30,000
1980	95,000
1981	250,000
1982	975,000
1983 (fall)	1,350,000

Source: British Broadcasting Corporation

* Average rate of growth for first five years: 145%

In Sweden and Finland, where teletext has been available for four years, growth rates of decoders have equalled or surpassed the British experience. Moreover, user reactions to teletext have been positive. For example, in the United Kingdom (U.K.) where leasing television sets is much more common than in this country, a manufacturer's survey of those leasing teletext decoders found that approximately 90 percent either intended or were leaning toward a decision to renew their contract for a teletext set.

During the period 1980-83, several commercial broadcasting groups and public broadcasting stations conducted teletext trials. These included: CBS/KCET/KNXT in Los Angeles, Field

Enterprises (WFLD) in Chicago, Alternate Media Center/WETA in Washington, D.C., WKRC in Cincinnati, KPIX in San Francisco and WGBH in Boston. Each had a small number of decoders in test homes or public locations. In general, the public reaction to these test services was positive. Further, both CBS and NBC have announced that each will begin a national teletext service in 1984. The potential for teletext to enter U.S. households, however, is hindered by a lack of available decoders.

In attempting to develop a scenario for teletext growth, we have drawn upon research data from the Alternate Media Center/WETA teletext trial in Washington, D.C. Their research suggests that approximately half of those purchasing a new color television set might purchase a teletext option. The figures in Table 18 project how teletext might grow if 50 percent of new television set buyers eventually chose a teletext option. It is assumed in Table 18 that teletext televisions will be widely available in 1986 but that sales from 1986 through 1990 will not reach the volume indicated by the Alternate Media Center research.

Table 18. Scenario for U.S. Teletext Market Growth, 1986-90*

Year	Estimated Color TV Sales (millions of units)	Percent of Sales with Teletext	Estimated Decoder Sales (units)
1986	12.0	5%	600,000
1987	12.5	10	1,250,000
1988	12.5	25	3,125,000
1989	13.0	40	5,200,000
1990	13.0	45	5,850,000
Total			16,025,000**

Source: Carey and Moss

* This scenario is contingent upon two important elements. First, it assumes that decoders will indeed be widely available in 1986. Second, it assumes that promised solutions to teletext reception problems are forthcoming.

**This would represent a penetration rate of 16 percent.

Table 18 suggests that teletext penetration of U.S. households is likely to be moderate by the end of the decade. From this perspective, teletext appears attractive for public broadcasting since the cost of maintaining the service is relatively low; however, it lacks the capacity or interactive capabilities of videotext.

Cabletext

"Cabletext" can provide a number of alternative services. The 1983 Time, Inc., trial in San Diego and Orlando provided a few thousand frames of information to test homes. This one-way service allowed users to select from a large stream of

pages continuously transmitted over one 525-line channel. The Cox cabletext trial in San Diego provided an interactive service wherein a user could access pages from a database as well as make purchases and conduct electronic banking. Finally, open channel text services--requiring no decoder--have been available on cable for more than a decade. Indeed, more than 60 newspapers or news services currently provide open channel text services for cable systems.

Cable brings two assets to electronic text services: a rugged transmission environment (compared to broadcast VBI) and an existing body of subscribers who have already committed themselves to paying for communication services. In addition, cable does not have to address the issue of transmission standards. However, cable shares with broadcast teletext a need to attract manufacturers who will build large quantities of decoders.

Research data emerging from videotext and teletext trials can be applied, with some modifications, to those cabletext services that mimic a videotext or teletext model. For example, no data appear to support the argument that large numbers of consumers will pay $40 to $50 per month for an interactive text service on cable. An advertiser-supported VBI text service that is free to cable subscribers will probably grow at a moderate rate because it requires only the purchase of a decoder. A large one-way cabletext channel offered for a fee of $7 to $10 per month will have to compete with pay

movie and sports channels. Nonetheless, a moderate market may exist for such a pay channel. It is instructive that both Time, Inc., and Cox Cable suspended cabletext services upon completion of their 1983 trials. Cox announced that it intends to redesign and upgrade its cabletext service and probably offer it to the public in 1986. Time, Inc., has indicated that its service was hindered by high production costs and a lack of decoders at a price the market could support. Time, Inc., intends to continue monitoring electronic text services but has no immediate plans to launch a service of its own.

Finally, open channel text services offered at no cost to subscribers and requiring no decoder will continue to receive moderate viewership. A.C. Nielsen reported that approximately 60 percent of 1982 cable subscribers viewed a news text service daily while 70 percent viewed a weather text service daily.

Public Broadcasting

Our analysis of opportunities for public broadcasting in electronic text builds upon the following:

- Research data from trials suggest that few consumer applications of videotext information services are likely to be financially viable during the 1980s. Transactional videotext services such as electronic banking and highly targeted services such as videotext in support of college courses appear to be more viable in the near term.

- While VBI teletext is likely to gain market acceptance, the service cannot begin on a large scale until 1985 or 1986. Thereafter it is likely to grow at a moderate rate.

- Large interactive cabletext and videotext systems will be costly to operate. The financial commitment required to launch such systems would appear to be more feasible for large commercial organizations rather than public broadcasting groups. Some public broadcasting organizations, however, may be able to develop an affiliation with commercial operators to offer, for example, interactive text services that support telecourses.

At the same time, electronic text has the following attractions for public broadcasting:

- Public broadcasting currently has expertise and trained personnel in electronic text through the activities at KPBS, KUON, WGBH, WHA and WUFT, among other stations.

- Public broadcasting has fully operational systems in place at a few stations, and a large body of research data on U.S. consumer preferences for electronic text services.

- Electronic text services may provide a means to attract new viewers to public broadcasting.

This list of barriers and opportunities can be used to support a case for a careful, systematic entry by public broadcasting into electronic text.

5. VIDEOCASSETTES AND VIDEODISCS

Videocassettes

Videocassette recorders have experienced strong growth since their introduction into the home market in 1976 (see Table 19 for the growth of home VCRs through fall 1983). Table 20 plots the sales of prerecorded cassettes for those years for which data are available.

Table 19. Growth of Home Videocassette Recorder Market, 1976-83

Year	VCRs in Homes* (units)
1976	40,000
1977	190,000
1978	550,000
1979	1,000,000
1980	1,800,000
1981	2,900,000
1982	4,230,000
1983 (fall)	6,900,000

Sources: Electronic Industries Association, The New York Times

* Estimated penetration rate for U.S. households in fall 1983: 8.2%

Table 20. Sales of Prerecorded Videocassettes, 1978-83*

Year	Videocassette Units Sold	Retail Revenue (in millions)
1978	600,000	$34
1979	1,200,000	65
1980	2,000,000	110
1981	4,500,000	250
1982	6,900,000	360
1983 (estimate)	10,000,000	500

Source: Carey and Moss

* These figures are exclusive of sales involving pornography, or illegal sales of pirate cassettes, both of which are strong components in the overall retail market. These figures also do not reflect videocassette rentals, which account for substantial additional revenues.

In 1976 VCRs entered the market with a retail price of $1,000 to $1,400. By 1983, the price had dropped to a range of $400 to $900. Prerecorded videocassettes during 1980-83 retailed in a general range of $40 to $70, with an average price of $50. In 1983, however, a few distributors dropped the prices of selected videocassettes to under $40. The market responded with markedly increased purchases.

The official best seller list of tapes contains movies predominantly. A few music concerts, exercise videocassettes and home education tapes have achieved moderate to strong sales in 1983. An estimated 30 percent of all sales, however, are pornography, although this percentage has declined steadily

in the past five years. During the early years of home VCRs, an estimated 70 percent of videocassette sales were pornography. Indeed, X-rated tapes may be the major reason for the successful launch of home videocassettes.

With little or no planning by industry suppliers, a large rental market for videocassettes emerged in 1976 and 1977 and has grown steadily. Since this market has been controlled by individual retailers (and many of the rentals have been illegal), few reliable statistics exist on the growth of videocassette rentals. A recent survey, however, by a reliable trade group estimated the 1983 videocassette rental market at $712 million. This includes approximately 237 million rentals at an average price of $3. The survey revealed further that approximately one half of VCR owners rent videocassettes occasionally or frequently.[4]

In the first six years of the videocassette rental market, individual retailers bought or illegally copied movies, then rented them to consumers. Thus, producers such as Walt Disney Productions realized no revenue from the rental of their materials and only limited revenue from the sale of videocassettes to retailers. But agreements between major distributors and retailers are now changing. For example, Walt Disney has established separate sales and rental programs, each with a distinct inventory. A retailer may sell only those films designated as "For Sale" and rent only those films

4. See Leisure Time Electronics, September 1983, p 38.

designated as "Rental Cassettes." The dealer must pay a flat fee for the right to rent each separate tape during a fixed three-month period.

Tables 21 and 22 chart estimates of sales growth for VCRs and prerecorded videocassettes. With limited data available on rentals, it is difficult to estimate growth for the cassette rental market during the 1980s.

Table 21. Projected Growth in the Consumer Market for VCRs, 1983-1990

Year	VCRs in the Marketplace (millions of units)	Percent Penetration Households
1983 (estimate)	8.1	9.4%
1985	14.5	16.3
1990	25.6	26.1

Source: Carey and Moss

Table 22. Projected Prerecorded Videocassette Sales, 1983-90

Year	Videocassettes (millions of units)	Retail Revenue* (millions)
1983 (estimate)	10	$500
1985	16	720
1990	34	1428

Source: Carey and Moss

* The average retail price for a prerecorded videocassette was $50 in 1983, but it is expected to drop moderately during the next few years.

The projections in Tables 21 and 22 assume that the sale of videocassette recorders and prerecorded tapes will continue to grow at a rate calculated from the baselines in Chapter 2. It is possible that competition from videodisc or other home electronic products might reduce the projected figures in Tables 21 and 22.

Videocassettes appear to represent a current opportunity for public broadcasting and one which will grow in the 1980s. Although the existing appetites for video materials lean heavily toward movies, there appears to be an emerging, small market for educational, self-improvement and arts materials.

Videodisc

The introduction of the videodisc to the consumer market in 1979-82 was flawed in several respects. First, three competing and noncompatible videodisc systems confused the marketplace (one of these systems has since been withdrawn from the U.S. market). Within one system--laser videodisc--competition among major industry groups led to further division of the market. A second major problem for videodiscs has been the absence of software. Unlike a videocassette unit, the videodisc player cannot record. The user relies solely on prerecorded discs. With few discs and virtually no original videodisc programming available to consumers during 1980-82, there was little incentive for consumers to purchase players. A third problem associated with the introduction of videodiscs has been the extraordinary hyperbole put forth by

some of its proponents. The reality of the early market certainly did not meet their expectations. This in turn led to some pronouncements of doom for the industry. Finally, the laser disc system was plagued by manufacturing problems in 1980 and 1981.

In spite of an aura of failure that has shadowed videodiscs, there are some indications that a strong consumer appetite for discs might emerge. Table 23 plots the recent growth of videodisc players.

Table 23. Growth of Consumer Videodisc Market, 1979-83

Year	Total Videodisc Players*
1979 (test market)	---
1980	35,000
1981	165,000
1982	390,000
1983 (fall)	600,000

Source: Electronic Industries Association, The New York Times.

* Data are for all laser and CED systems.

The first few years of growth in videodisc player sales has exceeded the sales of videocassette recorders during the first few years of their availability. The more important figures, however, are those contained in sales data for videodiscs. RCA expected that a consumer would purchase

seven to ten discs during the first year of owning a player, and five discs per year thereafter. In actuality, the typical owner has purchased (or received as gifts from friends) 20 to 30 discs in the first year of ownership.

Sales figures for discs (more than 90 percent of sales are for movies, at an average price of $25 to $30) have encouraged an analogy between videodisc and razors: manufacturers virtually give away razors because their revenues come from the sale of razor blades. Perhaps for this reason, RCA has drastically cut the price of their basic CED players to between $250 and $350 retail.

In Table 24, sales of videodisc players and discs are projected through 1990. An inference is drawn that player sales will continue to grow at the same rate as VCRs in their early marketing period. Sales of discs are based upon a conservative interpretation of the first two years of sales projected over time.

Table 24. Projected Growth of Videodisc Sales, 1983-90*

Year	Videodisc Players in Market (millions of units)	Videodisc Sales Per Year (million discs)	Disc Revenues (million)
1983	0.7	9.0	$ 225
1985	2.8	19.6	490
1990	7.8	54.6	1,092

Source: Carey and Moss

* Data are for all laser and CED systems in consumer homes. Figures for 1983 are estimates of year-end players in homes and disc sales.

If the videodisc industry follows this path of development, revenues from the sales of discs are likely to be substantial. Moreover, a significant revenue stream is likely to come from the education and corporate training markets, as well as the home market. The U.S. Army, for example, has invested heavily in videodiscs for education and training. In addition, the videodisc industry received a major boost in 1983 with the success of a new type of video arcade game that is based on videodisc animation rather than microprocessor-based animation.

The potential market among consumers and in education provides sufficient reason for public broadcasters to monitor videodiscs closely. It should also be noted that public broadcasting currently has considerable expertise in videodisc production, e.g., the Nebraska Videodisc Design/Production Group.

6. AUDIO AND VIDEO TELECONFERENCING

Video Teleconferencing

Video teleconferencing is not a new service. In the early 1970s, 23 video teleconferencing systems were operating in the U.S., with a smaller number in Canada and the United Kingdom.[5] Experimental systems began in the mid-to-late 1960s. The service has been less than successful, however. Of the 23 systems begun in the early 1970s, only five are still operating. Thus recent attention directed toward video teleconferencing represents a cyclical resurgence of interest in the technology, not the emergence of a new untested, service. It remains an open question whether the early history of the service will be repeated.

Much of the early interest in video teleconferencing was based on a need to provide services to remote areas as well as a concern about the high cost of travel. In particular, it was believed that video teleconferencing might substitute for a proportion of business travel. These motivations were boosted by the oil embargo and energy crises in 1973-74. But strong user demand for video teleconferencing never emerged.

5. See Martin Elton and John Carey, Implementing Interactive Telecommunication Services (New York: Alternate Media Center, 1980); Ben Park, An Introduction To Telemedicine (New York: Alternate Media Center, 1974); and Ederyn Williams, "The Bell Canada Conference Television System" (London: Communication Studies Group P/73173/WL, 1973).

The high cost of the service is cited as the principal reason. Most users found that audio teleconferencing or audio with some graphics or facsimile enhancement was sufficient for their needs. The relative cost of audio teleconferencing (on the average 50 to 100 times cheaper than video teleconferencing) further enhanced its acceptability.

Of those video teleconference systems that have continued since the early 1970s, all are dedicated, on-premise systems used on a regular basis by a relatively small and stable population. Thus there is no evidence from early experience with video teleconference systems to support an off-premise, irregularly used video teleconferencing service. Indeed, the industry's current marketing push appears related more to the excess capacity of the Holiday Inn satellite network, PBS satellite network and AT&T video lines than to customer demand for the service.

Many estimates of growth for video teleconferencing assume a base year of 1976, when a few on-demand, video teleconferencing services were commercially available (PSSC and AT&T's Picturephone Meeting Service). While data are very intermittent for the period of 1976 through 1981, it is estimated that a growth rate of 40 to 50 percent per year will occur for large-scale video teleconferences during 1984 and 1985 (see Table 25).

Table 25. Projected Growth of Nondedicated Video Teleconferences, 1981-85

Year	Video Teleconferences
1981	90
1982	160
1983 (estimate)	240
1984	335
1985	470

Source: Carey and Moss

It is difficult to estimate the growth of video teleconferences during the second half of the decade. On the one hand, the current high cost of video teleconferencing provides a barrier to growth. In addition, research data suggest that video is not necessary for all but a small percentage of teleconference meetings. On the other hand, some technical advances in video compression will reduce the cost of video teleconferencing. This may provide an incentive for additional usage.

Our analysis also suggests that few opportunities are likely to emerge for government teletraining via video teleconferences. The GSA, NASA and the Veteran's Administration have explored alternative means of teletraining for over a decade. Their data suggest that audio teleconferencing is by far more cost effective. Further federal budget policies are likely, in our judgment, to discourage renewed exploration of video teleconferencing (see Table 26 for the relative costs of

current audio and video teleconferencing).

Table 26. Audio and Video Teleconferencing Costs

Relative Costs of a One-Hour, Ten-Site, National Teleconference

Audio		Video	
Service	Cost*	Service	Cost
Private Bridge	$240	PBS	$ 5,750 - 10,200
AT&T	360	Commercial	22,600 - 34,500
Kellogg	345		
Darome	425		

Sources: Carey and Moss; Browne, Bortz and Coddington

* Estimated costs of audio teleconferences assume an average distance of 1,200 miles between each site and the bridge.

The costs for audio teleconferencing in Table 26 do not include enhancements such as slow-scan television or end instruments such as speakerphones. Such enhancements introduce much cost variability. The large cost differential between audio and video teleconferencing would remain under most scenarios of enhanced audio, however.

In comparing PBS-based video teleconferencing and commercially available services, issues of cost, convenience and ancillary advantages arise. Public broadcasting can compete in terms of cost, but it is weak in terms of convenience and side benefits. Table 27 outlines the relative advantages and

disadvantages of PBS, commercial services such as Hi-Net, and AT&T's Picturephone Meeting Service.

Table 27. Advantages and Disadvantages of Teleconferencing Services*

Issue	PBS	Hi-Net	Picturephone Meeting Service
Cost	+	-	+
Convenient Scheduling	-	+	+
Side Entertainment	-	+	-
Location of Sites	-	+	-

Source: Carey and Moss

* A "+" indicates a relative advantage, and a "-", a relative disadvantage.

Based on these considerations, it is our judgment that a small video teleconference market will likely emerge, and public broadcasting may compete successfully for a share of the market. The estimates of potential revenue for teleconferencing services in 1985 range from $500,000 to $2,000,000. This sum is not necessarily adequate to justify significant upgrading of public broadcasting facilities for video teleconferencing. It appears that the single most important need is for coordinated scheduling so that a customer may conveniently arrange a multisite video teleconference by speaking to one individual.

Local Video Teleconferencing

Some public broadcast stations may be in a position to develop revenues from local or statewide video teleconferencing via Instructional Television-Fixed Service (ITFS), MDS or low-power broadcast. This application is discussed in the section on Alternative Distribution Technologies in Chapter 8.

Audio Teleconferencing

The cost of a one-hour, ten-site audio teleconference via public radio stations is approximately $515. This includes a one-way link to each of the sites. Interactive capability among the sites would be more costly. By comparison, each of the audio teleconference services outlined in Table 26 is cheaper, while providing full interactive capability among all the sites. Furthermore, a National Public Radio service is less convenient than other audio teleconference services because users must travel to a public radio station's studio (or incur additional costs for transmission to their business or school).

Consequently, there appears to be little opportunity for national teleconferencing via public radio. However, there may be an opportunity for local or statewide audio teleconferencing via SCA. This application is discussed in the section on Alternative Distribution Technologies in Chapter 8.

7. PERSONAL COMPUTERS AND VIDEO GAMES

Personal computers and video games appear to embody a new means to extend educational activities. At the same time, however, they represent a significant shift in content form, one which varies from public broadcasting's existing expertise in audio and video programming.

Personal Computers

The personal computer entered the marketplace in a major way during 1978. This followed a series of advances in microprocessor technology that reduced the price of smaller computers to less than $2,000. Table 28 charts the growth of personal computers in U.S. households since 1979. It is difficult to define household penetration since many personal computers are used for both business and home applications. In addition, there is disagreement about the categorization of very inexpensive computing devices as "computers." Table 28 includes this low end market (under $200) as well as computers that are used primarily for a business-at-home.

Table 28. Growth of Home Computer Market, 1979-83

Year	Unit Sales
1979	76,000
1980	137,000
1981	181,000
1982	1,750,000
1983 (estimate)	4,000,000
Total Sales	6,144,000*

Sources: Gallup Organization, The Washington Post

* Estimated penetration of U.S. households at the end of 1983: 7.2%

Based upon these early sales figures, it is reasonable to estimate an average growth rate for home computers of 25 to 30 percent during the remaining years in this decade. There are some reasons to believe that sales of home computers will grow at a somewhat greater rate if their prices continue to drop. The figures in Table 29, however, proceed in a straightforward manner based on the early sales figures.

By the end of 1982, approximately 400 to 500 thousand personal computers were in place at schools and colleges. At the time when this report was prepared, figures were not yet available for 1983. There are indications, however, that personal computers will enter the U.S. educational system at a very rapid rate throughout the 1980s.

Table 29. Projected Growth of Home Computer Market, 1983-90

Year	Units in Homes
1983 (estimate)	6,144,000
1985	9,500,000
1990	26,700,000*

Source: Carey and Moss

* Estimated penetration of U.S. households in 1990: 27.2%

By 1985 a large market will exist for educational software designed for use in schools and homes. Indeed, the sale of software for personal computers may then be a larger and more profitable business than the sale of hardware. At a national level, public broadcasting has little expertise in developing software for personal computers. Some resources do exist at public broadcast stations with university and state education affiliations.

One reasonable approach to the software market is that of a publisher or distributor. An extraordinary number of private entrepreneurs are currently creating software--at universities and in living rooms. Some of this software is sold through small ads in computer magazines. In addition, several publishers have moved into the software publishing area. Public broadcasting may find an appropriate role as a publisher of cultural, informational and educational software. In such a role, stations would not create software.

Instead, for-profit subsidiaries at selected stations would evaluate existing software and develop licensing arrangments with those who have created what are deemed to be marketable software products.

Video Games

Video games have made an extraordinary early penetration into American households: approximately 14 percent by the fall of 1983 and an estimated 17.7 percent by the end of 1983 (Table 30).

Table 30. Growth of Video Game Market, 1976-83

Year	Units in Marketplace
1976	80,000
1977	250,000
1978	600,000
1979	750,000
1980	1,050,000
1981	3,100,000
1982	10,625,000
1983 (estimate)	15,100,000

Sources: The New York Times; Business Week

During their first five years in the marketplace, video game console sales grew at an average rate exceeding 100 percent per year. Based upon this rate, a growth rate of

approximately 35 to 45 percent is estimated for the period of 1984 through 1985. In the second half of the decade, video games are likely to face the test of long-term demand. It is possible that they will prove to be a ten-year fad and level off or decline in the period 1985 through 1990. Moreover, the high end of the video game market may shift to personal computers, which can also supply games, during the second half of the decade. For this reason, the growth of video games beyond 1985 cannot be estimated. Indeed, it may be difficult to distinguish video game consoles from personal computer consoles after 1985.

Table 31. Projected Growth of Video Game Market, 1983-85

Year	Units in Marketplace	Penetration of U.S. Households
1983 (estimate)	15,100,000	17.7
1985	28,400,000	31.9

Source: Carey and Moss

As in the case of personal computers, more revenue may be realized from the sale of software (in this instance, game cartridges) than of the hardware or video game console. By 1981, more than ten cartridges had surpassed the million-seller mark. Total revenues from the sale of approximately 60 million cartridges in 1982 were $1.2 billion. In 1983, approximately 75 million cartridges were sold. Profit margins were low, however, due to strong competition and heavy discounting.

Pricing of cartridges vary, but most fall in a $16 to $35 range. An estimate of 8 to 10 cartridge purchases over the lifetime of a video game console is reasonable and conservative. There also is some evidence to suggest that a small percentage of this market could be attracted to educational games. As in the case of educational toys, it would consist largely of a gift market. Such educational games are likely to be aimed at 7-to 12-year-olds and teach simple logic or geometric associations. In addition to their subject area, such games can help prepare the audience for interaction with personal computers.

In attempting to construct a scenario for sales of educational cartridges, it has been estimated that an average of three cartridges will be purchased in 1985 for each video game console (households with new video game consoles are likely to purchase more cartridges, while households with older consoles are likely to purchase fewer cartridges). Of these purchases, educational cartridges could attract ten percent of sales (see Table 32).

Table 32. A Scenario for Educational Cartridge Sales in 1985

Est. Sales of Cartridges* (million units)	Estimated Sales of Educational Cartridges (million units)	Average Price Per Cartridge	Est. Gross Revenues, Educ. Cartr. (million)
85.2	8.57	$20	$171.4

Source: Carey and Moss

* Estimates for sales of cartridges are based on 28.4 million video game consoles and an average of 3 cartridges for each unit.

An effort by public broadcasting to capture a portion of the educational cartridge market might be linked to efforts in the personal computer software arena. One possible role for public telecommunications entities would be as a publisher or in a joint venture with a publisher. It is important to note that the software markets, both for video games and personal computers, are highly competitive. Many companies suffered financial losses in 1983 despite strong industry-wide sales. For this reason, it will be important for any public broadcasting group contemplating a software venture to carefully analyze this market.

8. UNTESTED NEW MEDIA AND ALTERNATIVE DISTRIBUTION TECHNOLOGIES

This chapter examines two groups of technologies and services: new media that have just been introduced to the market or have yet to be introduced, such as high-definition (HDTV) television and digital records; and alternative distribution technologies for public television and radio products, such as MDS, STV, DBS, low-power TV and SCA.

Digital Records and High-Definition Television

Digital records entered the U.S. market in 1983, but it is too early to know whether a large percentage of the consumer market will adopt them. They represent a significant advance in recording technology, with greater dynamic range and increased signal to noise ratio. This translates into less hiss on the sound track, even after many generations of editing and rerecording, and greater range for loud and soft passages.

The characteristics of classical music are particularly suited to digital recording. Hence, it may be argued that if digital recordings receive consumer acceptance, classical music is likely to benefit. Attention might be directed towards record distribution rights for performances taped under contract with public broadcasting.

High-definition television provides significantly sharper images: approximately four times the resolution of 525-line images. In order to implement HDTV, new recording equipment

is required as well as new television receivers and greater spectrum space for transmission (digital compression techniques may reduce somewhat the requirements for additional spectrum space). Prototype recording equipment and receivers have already been developed. In addition, CBS is actively lobbying to secure spectrum space; they have proposed that direct broadcast satellites be used for HDTV. In addition, they have proposed the linkage of two or more channels on MDS or UHF in order to provide the necessary bandwidth.

It is unlikely that HDTV will achieve significant penetration into U.S. households in this decade. It appears more likely that HDTV will develop, initially, as an alternative to 35mm film in motion picture recording and as a medium for exhibits in public places such as Disneyland or the Smithsonian. It may also be used to project special live events, such as a championship fight, in movie theaters. In the second half of the decade each of these applications are likely to be in place. HDTV for homes may begin in this decade, but the high cost will probably limit its penetration. If the public reacts positively and strongly to HDTV when they first encounter it, the implementation process could accelerate.

Alternative Distribution Technologies

Low-power television, multipoint distribution service, subscription television, Subsidiary Communications Authorization and direct broadcast satellites are all alternative broadcast

distribution paths. Each provides, or should soon provide, a means for public broadcasting to reach more specialized audiences. In addition, low-power television and direct broadcast satellites appear especially well suited to reach rural areas not currently served by public broadcasting.

Subscription television (STV) utilizes a scrambled broadcast signal as a means to offer pay programming. The signal is descrambled in homes that lease equipment in order to receive the programming. The term STV, however, is used typically in relation to full-power UHF or VHF stations. In the current market, STV provides a way for consumers to receive a pay movie service in areas where there is no cable. During the period 1977 to 1981, STV grew into a significant market (see Table 33). Beginning in late 1982, however, STV began to lose customers due to greater competition from cable and higher operating costs that in turn led to increased prices for consumers. In 1983, STV subscribers paid an average of $25 to $30 per month for the service.

The growth of STV on UHF and VHF is not certain. A number of STV channels, after experiencing a loss in subscriber base during 1982 and 1983, have closed down. The base of subscribers has continued to erode during 1983.

Table 33. Growth of Subscription Television, 1977-83

Year	Subscribers
1977	40,000
1978	150,000
1979	400,000
1980	650,000
1981	980,000
1982	1,380,000
1983 (estimate)	800,000*

Sources: Federal Communications Commission; National Association of Broadcasters

* Estimated penetration of U.S. households at the end of 1983: 0.9%

Multipoint distribution services provide an omnidirectional microwave transmission that requires special equipment to receive the signal. It is somewhat cheaper to operate and receive than UHF or VHF STV. Therefore, an MDS movie channel operator may be able to break even with 15,000 to 20,000 subscribers, whereas UHF or VHF STV typically requires 75,000 to 90,000 subscribers in order to break even. The average monthly subscriber fees for MDS movie channels ($20 to $25) are also lower than STV. Nonetheless, MDS also experienced an erosion of its subscriber base during 1983 (Table 34).

Table 34. Growth of Multipoint Distribution Services, 1976-83

Year	Subscribers
1976	45,000
1977	70,000
1978	140,000
1979	280,000
1980	400,000
1981	547,000
1982	850,000
1983 (estimate)	550,000*

Sources: Federal Communication Commission; National Association of Broadcasters

* Estimated penetration of U.S. households at the end of 1983: 0.6%

MDS transmission has many applications beyond pay movie channels. It can be used for private video or data transmission. The 525-line signal can also be divided and leased to several groups. Indeed, some MDS operators offer a pay movie channel at night while leasing transmission space to businesses during the day. With the allocation of additional spectrum space to MDS (the FCC has decided to take spectrum space away from ITFS transmission and assign it to MDS), many new applications are likely to emerge. For example, it is suggested that two or more MDS channels could be linked to provide high-definition TV simulcasts of major sporting events. Alternatively, some groups seek to offer a pay multichannel MDS service that might

compete directly with cable.

From a public broadcasting perspective, MDS may provide one additional means to help with the "last mile" problem for program transmission. It may be argued further that public broadcast stations and groups associated with them who currently hold ITFS licenses should be given special preferences in multichannel MDS licensing.

Both STV and MDS provide a means for local video teleconferencing. Although most planners conceive of video teleconferencing as a service that spans great distances, most of the successful video teleconference systems are private networks, used regularly, over a short distance, such as those used by the Department of Energy, Philadelphia Police Department, Phoenix Police Department and Public Defenders Office, and the Irvine School System. Some local public broadcast stations licensed to provide MDS may find leasing time for local video teleconferencing an attractive avenue for modest additional revenues.

Subsidiary Communications Authorization (SCA) provides a medium for private or narrow audience programming by piggybacking an extra audio signal on FM transmission. Thus it can provide one means to help solve the "last mile" problem in audio programming. For some time, public radio stations have used SCA for narrow audience transmission, such as programming for the blind.

The SCA can provide an additional service: local audio teleconferencing. As in the case of video teleconferencing,

there is a commonplace assumption that audio teleconferencing works best across great distances; however, local and/or statewide audio teleconferencing has proven valuable in a number of states, including the University of Wisconsin-Extension and Vermont Teleconferencing, Inc. An SCA model of audio teleconferencing can be cost effective for groups who wish to link many sites in a given area on a regular basis. Each location must be equipped with a $100 to $150 SCA receiver (a one-time purchase), but the cost of transmission remains constant for five or 100 sites within the range of the radio station. Interaction can occur by telephone bridging of the principal speaker sites. Other locations can participate by using a call-in format. SCA teleconferencing is not likely to meet the needs of groups with strong concerns about security or privacy.

Our assessment of the comparative costs for SCA teleconferencing and commercial telephone-based audio conferencing suggests that SCA would be cheaper for groups that need to reach ten or more sites on a regular basis, such as a monthly teleconference among school principals in a city.

Direct broadcast satellites and low-power television represent strong potential tools for transmitting additional public programming, as well as for reaching many of the U.S. households (approximately eight percent) that cannot currently receive a public broadcasting signal. There are, however, regulatory uncertainties associated with both of these

technologies.

Currently more than ten organizations have proposed to offer a DBS service. The parties propose two to six channels per satellite service and would combine movie channels with general entertainment as well as some data services. In most proposals, DBS is likely to provide pay services with subscribers leasing a receiver. The cost of equipment required to receive the signal, exclusive of monthly subscription fees, is projected to range between $300 and $600.

While COMSAT argues that they will generate five million subscribers by 1986, others question these projections. Indeed, many analysts believe that only one or two DBS services can exist on a profitable basis.

The FCC adopted interim rules on DBS in 1982 and authorized several systems. In November 1983, United Satellite Communications began a five-channel DBS service directed towards a limited market in the midwest. A few other groups have postponed their plans to launch a service. They appear to be concerned about the high costs associated with launching a service as well the competition for a limited market. In addition, a few regulatory issues are likely to slow DBS. For example, many terrestrial microwave operators are concerned about interference from DBS and may petition the FCC to delay services. Certainly, the role of HDTV within DBS will provide fuel for a debate and may slow the development of services.

It appears that DBS will become a full service in the second half of the 1980s, with some national services beginning in 1984 or 1985. It will likely be well received in rural areas and some other noncable areas. We are not certain about its appeal in major cities. Some cable operators may argue that DBS is ideal for inner cities--where cable operators are reluctant to build, but subscription to DBS is almost certain to be more expensive for the consumer than basic cable. DBS, therefore, does not represent a more beneficial technology than cable for inner city residents.

In addition, DBS represents a means to create new broadcast networks. That is, DBS can be beamed to local MDS, STV and low-power stations. They in turn may retransmit it to homes and schools. Such a network might represent an opportunity for public broadcasting, although it appears prudent for public broadcasting to postpone any commitment while monitoring regulatory and market developments in DBS.

In early March 1982, the FCC opened the way for construction of 3,000 to 4,000 low-power TV stations. It is still not clear how this service will develop. The FCC has been flooded with applications and construction permits are being issued at a very slow rate. Some groups who saw an opportunity to create low-power STV stations are now reassessing this prospect in light of recent STV market developments. Currently applications for rural area low-power stations are being processed by the FCC. For this reason,

it appears that low-power TV will present public broadcasting groups with a near-term opportunity to reach new geographic areas currently unserved by a PTV station.

9. CONCLUSION

In general terms, new telecommunication technologies offer few opportunities for public broadcasting to extend services into underserved homes. The groups that need information services the most will be unable to afford most of the new technologies. Nevertheless, two exceptions may be noted in relation to home services.

First, low-power television can reach many homes not currently receiving a public broadcasting station. An ordinary television set can pick up a low-power TV signal, although an outdoor antenna may be required. Moreover, low-power stations cost far less to build than regular full-power stations.

A second technology that may enter large numbers of American homes, including some low income groups, is teletext. By the second half of this decade, a teletext decoder is projected to add approximately $200 to the cost of a regular TV. For this reason, teletext may become the only widely used electronic publishing system in American homes during the late 1980s. Public broadcasting may be able to use teletext as an electronic text channel for those who have no access to videotext or computer database systems. The current uncertainty about teletext decoder availability, however, provides support for a conservative wait-and-see approach to teletext services.

Most of the technologies discussed in this report will create an information gap between those who have access to the new services and those who do not. This has been described as the creation of information "haves" and "have-nots." Television has brought social benefits and, some argue, social harm by making the same information available to all. We may be entering a new stage of communication development that resembles an earlier, pre-television era when books and newspapers were available selectively in a society--to those who could read and afford them. This potential shift in the communication structure of our society will require careful monitoring and analysis.

Two directions or roles for public broadcasting emerge from this research into the new technologies. These roles are not mutually exclusive, nor are they definitive. They represent opportunities for using the new technologies to complement the basic public broadcasting mission.

First, public broadcasting could emphasize applications of new technology for education. Public broadcasting can develop applications of new technologies, such as videodiscs, electronic text, VCRs and personal computers, for school environments where many students who do not have access to such technologies at home can use them. There are a number of arguments in support of this option. It is in tune with public broadcasting's mandate to serve the educational needs of citizens. There has been an absence of high-quality educational software from commercial groups, who have

concentrated on consumer and business applications for new technologies. There also is evidence that selected new technologies, particularly personal computers, will enter American schools at a very rapid rate during the 1980s.

This suggests a role for public broadcasting as a publisher of educational software. In addition, public broadcasting can develop pilot projects, then seek partners for broader distribution of programming that is demonstrably successful.

Second, public broadcasting could attempt to fill information gaps created by the new technologies, using normal broadcast channels. As the new services develop, public broadcasting can identify which groups are underserved and what types of information they are denied.

These target groups and information needs can be addressed in regular broadcast programming, which is available to all. For example, if a group falls behind in developing computer literacy, regular programming can attempt to raise the level of knowledge even if the group has limited access to computer terminals. Thus public broadcasting could serve a remedial function in relation to new technologies.

Finally, it is important to note that this research is not intended to recommend new technology ventures for public broadcasting to undertake in the 1980s. Rather, it has attempted to outline some relative strengths and weaknesses of new technologies and describe selected options that are

available to public broadcasting. In order to make informed decisions about new technology services and programming, available options must be further scrutinized from the perspective of public broadcasting policy, financial planning and community support.

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